Australia-ASEAN Academics Forum

Online education during Covid-19 and beyond.

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AUSTRALIA & SOUTH-EAST ASIA

INTELLIGENT INTERFACES AND FEEDBACK MECHANISMS FOR ONLINE EDUCATION

Remote Laboratory Case Study

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18/6/21

OUTLINE

- Online Education
  - Practical Education with Laboratories
  - Remote Laboratories

- Computational Intelligence
  - What it is …
  - How can it help in online education

ONLINE ENGINEERING EDUCATION

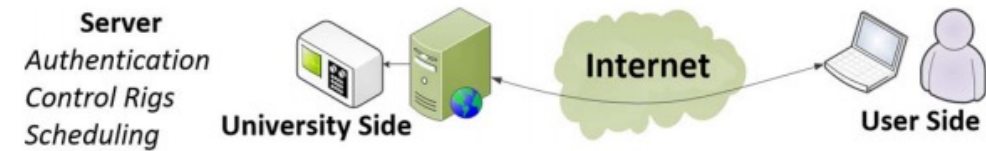Practical Knowledge

ENGINEERING EDUCATION

- Education related to engineering fields.
    - Involves learning a concept, strongly supported by mathematical models
    - Verifying the concepts through real-world examples
    - Service-learning

- Engineering Education includes various fields – general physics, chemical, mechanical, computer, electrical, architectural etc.

- Practical knowledge of engineering and its context is essential

ROLE OF LABORATORIES IN PRACTICAL EDUCATION

- Practical Education is a must in Engineering and Science
  - Revising the conceptual knowledge
  - Validating the knowledge with practical setups
  - Hands on Experience - how to do things
    - Safety
    - Efficiency
  - Collaboration and group work

WHAT DOES IT INCLUDE?

- An apparatus – the main hardware setup
  - Can be a rigid body big electronic devices
  - Can be a flexible body setup
  - Reconfigurable with software/electronically or mechanically

- Consumables

Server
Authentication
Control Rigs
Scheduling
University Side
Internet
User Side

WHAT DOES IT INCLUDE?

- ICT or computation only labs
  - Typically, when high end computing recourses are needed
  - Networking or AI

- Remote Desktop access

- UTAS Labshare was created to give ICT students access to the PC and Mac Labs for teaching purposes.

ONLINE LABORATORIES

- Remote laboratories are the online version of the practical experimental setup.

- The setup is connected to internet.

- Lets students access the learning materials and equipment anytime and anywhere.

- First appeared in early 2000s
  - Main need was to manage resources and give students more access
  - The online interface was basic
  - In early days, it was mainly about electronics experiments

EXAMPLES

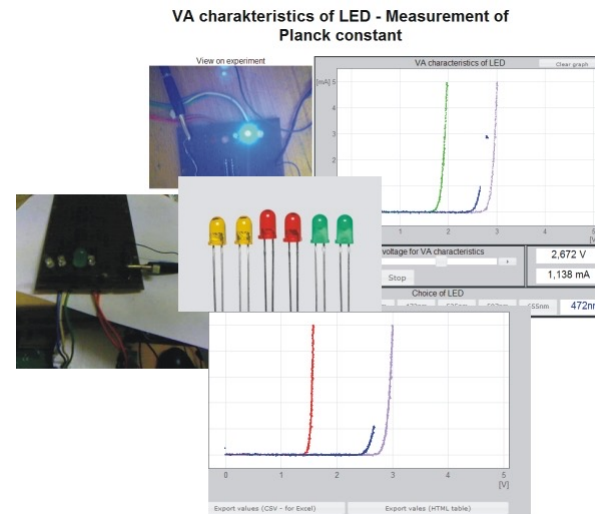- iLabs (US, Australia and various places)

- WebLab (Europe)

- REXlab (Brazil)

- Golabz

- iSES
  - https://www.ises.info/index.php/en/laboratory

ONLINE LABORATORIES

- Key aspects of the remote laboratories:

  - Scheduling:

    - Manage student's access

    - Different strategies: time slots, queueing

    - Student experience is different for each type

  - Web interface

    - Controls

    - Visual Feedback - Camera

WHAT WE DID IN UTAS

- Teaching of electronics and computer systems units
  - Since 2017 we had some form of remote laboratories for teaching embedded systems
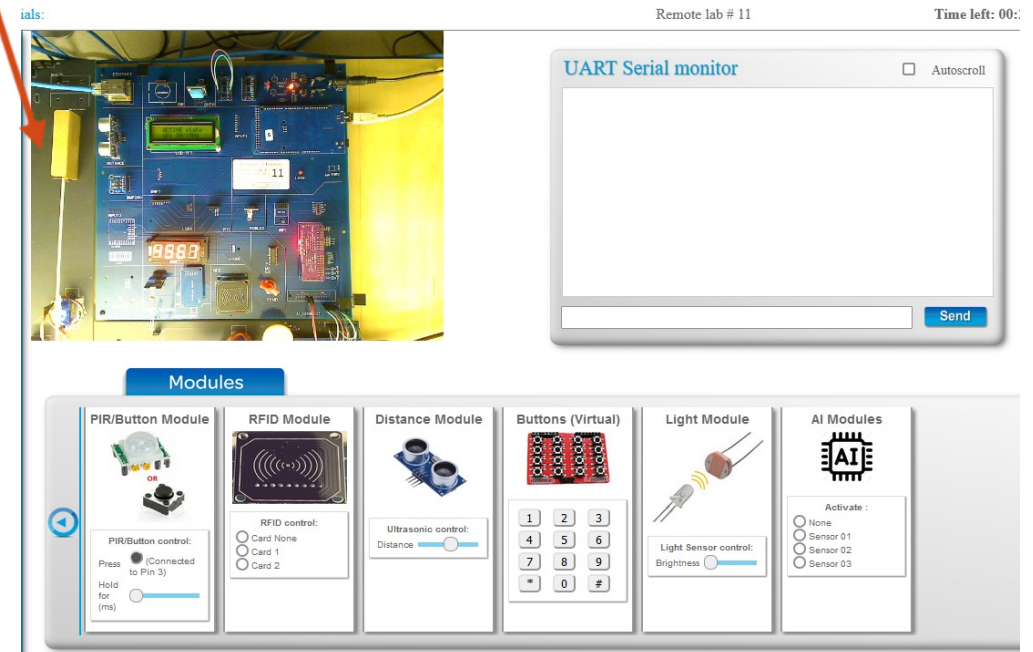 - Since 2020, this has been expanded to internet of things and web application units.

INTERFACES

Automation

Actual Devices

Web Interface

ONLINE LABORATORIES

- Key aspects of the remote laboratories:

  - Everything can be logged, unlike a classroom lab
    - Commands
    - Programs
    - Configuration Setup

PROBLEMS WITH REMOTE/ONLINE LABS

- Lack of hands-on experience
  - Virtual reality – needs ubiquitous devices

- Lack of collaboration
  - Shared web interface – network is an issue

COMPUTATIONAL INTELLIGENCE

INTELLIGENT COMPUTING IN EDUCATION

- Adaptive to student needs

- Figure out the problems – common hurdles

- 24x7 availability of support – improved version of google

INTELLIGENT COMPUTING IN EDUCATION

- Automation
  - Let the students submit 'anything'
  - Evaluate automatically

- Example:
  - Text mining –
    - Plagiarism
    - Marking

EXAMPLE

- Grammarly

  - allows the user to tweak a lot of parameters.

  - The software then measures the quality of the documents.

Set goals

Get tailored writing suggestions based on your goals and audience.

Audience   General   **Knowledgeable**   Expert

Knowledgeable (default): Requires focus to read and understand.

Formality   Informal   **Neutral**   Formal

Neutral (default): Restricts slang but allows standard casual expressions.

Domain   Academic   Business   **General**   Email   Casual   Creative

General (default): Applies most rules and conventions with medium strictness.

Tone   🙂 Neutral   🤝 Confident   😊 Joyful   ✌ Optimistic
🤗 Friendly   ⏱ Urgent   📊 Analytical   🙌 Respectful

Experimental. How do you want to sound? This helps us build new suggestions and won't affect your feedback today.

Intent   Inform   Describe   Convince   Tell A Story

Experimental. What are you trying to do? This helps us build new suggestions and won't affect your feedback today.

Performance

Text score: 93 out of 100. This score represents the quality of writing in this document. You can increase it by addressing Grammarly's suggestions.   **93**

Word Count

Characters	2,991	Reading time	1 min 44 sec
Words	436	Speaking time	3 min 21 sec
Sentences	33		

Readability

Metrics compared to other Grammarly users

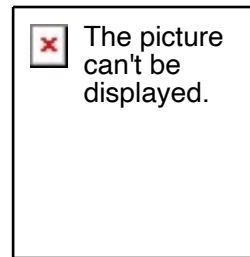|			
Word length	5.6		Above average
Sentence length	13.2		Above average
Readability score	34 ⓘ		

Your text is likely to be understood by a reader who has at least some college education, but it may not be easy to read.

APPLICATION OF AI

- Pattern Recognition
  - Train on data to create models
  - Match new information with the model

New Image

Training Images

Model (Neural Network)

It is a cat

APPLICATIONS IN REMOTE LAB

- Every input is recorded digitally - commands, programs, and configuration setup

- Real-Time data collection and storage

- The inputs for AI can be any of these

- **The outputs are:**

  1. The absolute quality of the input for any given task.

  2. Progress of the student with respect to time and peers.

  3. Feedback generation on the input based on its type.

1 ABSOLUTE QUALITY ASSESSMENT

- This is basically similar to marking an exam.

- We grade what ever the students upload or do on the web interface

1. *Input for AI:*
   - Student inputs to the experiments
   - Collected over a few semester
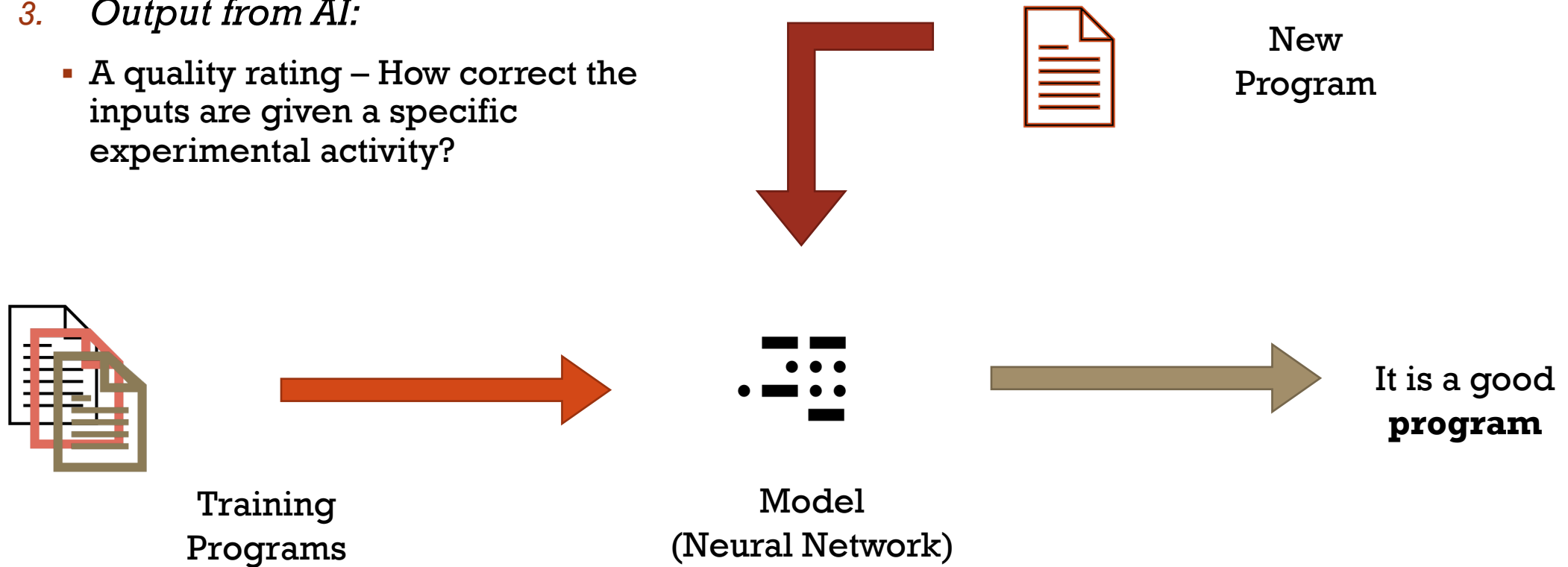   - The learning activities must be the same each time

2. *AI Model:*
   - Contains all possible classifications of student inputs

1 ABSOLUTE QUALITY ASSESSMENT

3. *Output from AI:*

   ▪ A quality rating – How correct the inputs are given a specific experimental activity?

New Program

Training Programs

Model
(Neural Network)

It is a good **program**

2 PROGRESS OF STUDENT

▪ Critical aspect of the student is to be able to complete tasks in time

  ▪ Learning goals - stages within each learning activities

  ▪ Every task and subtasks 'should' to be done in a time limit

  ▪ Live tracking of the student progress
    ▪ Check if someone is falling behind
    ▪ Check if student are not doing the right things

3 FEEDBACK GENERATION

- What to tell the student?

  - *Direct Feedback:*
    - Given the answer directly

  - *Indirect Feedback*:
    - Point out what should not be there in the inputs
    - Provide hint on what should be there

- Where to stop?
  - Ex. Grammarly has no end
  - But online learning cannot give all the answers
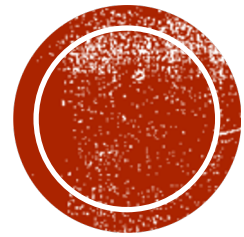
3 FEEDBACK GENERATION

- Real-time vs on-demand feedback

  - Should we provide feedback automatically – the system can monitor the students in real time.

  - Should the feedback be given only when student wants it.

- Depends on activities and the desired speed of the student

INSTRUCTIONAL DESIGN FOR REMOTE LABS

- Modular

- Single user focused
  - Scheduling two users at the same time is difficult.
  - Group based activities are difficult.

  - Activities typically take 10-15% more time for the students
    - Due to web interface
    - Client devices

  - Video based tutorials – not just text and images

CONCLUSIONS

- Remote labs has been used for simple access and control

- Augmented Learning experiences

- Can be supported with multiple AI tools for individual training

QUESTIONS ?

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18/6/21